

Case studies from classes led by Dr. Ron Fulbright, University of South Carolina Upstate.

INNOVATIVE ANALYSIS

POOL COVER INNOVATION

1. BRIEF DESCRIPTION OF THE SITUATION

When winter turns to spring, many households around the world uncover their swimming pools for warm weather fun. The cover is a plastic or vinyl tarp that covers the swimming pool's entire surface during the colder months to prevent leaves and other debris from falling into the water. There are several types of covers for different pools. In-ground pools can have covers that are weighted down by sand bags or strapped down by bolting the cover to the surface around the pool. Above-ground pool covers fit completely around the pool and are held in place by a cable that is tightened by a winch, or simply by a line of elastic that is sewn into the cover.

With every pool, a universal problem occurs - leaves and debris that have collected on top of the pool cover and fall into the pool as the cover is being removed. The cover is also very large and unmanageable for one person. It takes teamwork and good communication to keep the cover from falling into the pool water.

2. DETAILED DESCRIPTION OF THE SITUATION

2.1 SUPERSYSTEM/SUBSYSTEM ANALYSIS

Personal pools are installed in a range of different sizes, most of which are large enough for several people to move around in. The covers for these pools, therefore, have a comparatively large surface area against that of a human's span of reach. Covers have to be made in such a way that they stay in place, and there are several mechanisms that can ensure this, including weights, bolts, elastic, drawstrings, etc. Especially with weights and bolts, there are usually several of each of these along the circumference of the pool, all of which must be undone before removal. Covers must also not sink into the pool. Besides the methods listed previously, flotation devices may be placed into the pool to lift and hold the cover above the surface of the water. Covers may be made out of various materials and have several layers for the prevention of contamination by debris.

2.2 INPUT/OUTPUT ANALYSIS

The main input is the pool itself. No problems would occur if the pool did not exist. Water is put into the pool for swimmers to enjoy. The temperature has to drop for the leaves to start falling off the trees. Tree leaves and other debris contribute to the problem. By not covering the pool, the water becomes green because of the algae in the water. Algae can cause the water to contain bacteria that is harmful to swimmers. A pool cover has to be put on the pool by a person or people. This can become a problem because peoples' arm spans or reach (is not sufficient) and teamwork takes effort. By the cover being on the pool, leaves and dirt are caught on top and cannot fall into the pool. Also, a large amount of rain water collects on top of the cover. Small animals can become trapped and drown in the collected water and leaves. When the temperature becomes warmer, the cover on the pool is removed. The water stays on top of the cover until the water is evaporated by the sun or is drained off. The collection of rain water can be prevented by a flotation device under the pool cover. The leaves remain on top of the cover until they are removed by a person or the cover itself is being removed. By a person or people removing the cover, the leaves and debris collected on top fall into the pool water.

2.3 CAUSE/EFFECT ANALYSIS

The size of the pool cover may require multiple people to uncover the pool. Lack of communication could cause one side of the cover to be dropped, which would result in contamination of the pool water. Lack of physical coordination or timing, which may be common in children and teens who may be helping to uncover a pool, could result in the cover being dropped as well.

The flexibility and composition of most pool covers causes debris to slide around and off of the cover during the process of uncovering, causing contamination.

Any weights that are used to keep the cover in place must be removed while simultaneously keeping the cover from slipping into the pool; much effort is required. The same applies to the

use of bolts, elastic, and drawstrings - these items must be removed or undone while also tending to the cover. The cover may have debris and rain water on it, which may slide into the pool.

If heavy rain occurs during the time a pool is covered, the cover becomes weighted down over the surface area of the pool, and the water must be removed so that it does not contaminate the pool water.

2.4 PAST/FUTURE ANALYSIS

In the past many different types of covers have been used but none solve every aspect of the problem. The traditional past above-ground pool cover is usually a plastic tarp that covers the entire pool. The cover is held in place by cable or rope tightened by a winch. Most in-ground pools in the past have been covered the same way but held in place by a different mechanism. With an in-ground pool, the plastic tarp is held in place by weighted sand bags around the edge of the pool. With both above- and in-ground pools, many owners have chosen to put an inflatable “pillow” in the center of the pool under the tarp to prevent rain water from collecting on top.

Many swimming pool covers now and in the future will be much more than just a plastic tarp. Pool covers are starting to come with mesh netting that lies on top of the tarp. This net lifts off and removes the leaves with it. Covers are also being made to keep the pool from freezing in the winter time. These covers capture the sunlight, keeping the water warm. Safety pool covers are used to prevent children and animals from drowning. These covers are strong enough for a grown man to walk across. Safety covers are held in place by a thick strip and are bolted to the surface around the perimeter of the pool.

3. RESOURCES, CONSTRAINTS, AND LIMITATIONS

3.1 AVAILABLE RESOURCES

The pool's walls are made out of concrete if in-ground, and a vinyl lining with a steel or wooden framing for above-ground pools. Then of course there is also water, the chemicals in the water that keep the pool free from germs and algae, and the leaves, dirt, insects, and debris that are a part of the outside environment. Inside the pool are also filters and drains. The pool cover itself is usually made out of plastic or mesh. The cover is held in place by sand bags, a cable and winch, or elastic. There is a time limit – after more than ten minutes, most people would find the uncovering of a pool too tedious and involved. This also describes the situation with energy; it wouldn't be good for the person to be too tired to swim after uncovering the pool. Most people do not swim alone, so there are usually at least two people.

3.2 ALLOWABLE CHANGES TO THE SYSTEM

The water cannot be taken away. The cover may not be reduced so that it covers less than the surface area of the pool. The environment cannot be eliminated (we can't take nature away). The material that the cover is made of does not necessarily have to stay plastic; it can be changed. The way this cover is held in place can also be changed. The way the water and debris are drained / disposed of can be changed.

3.3 CONSTRAINTS AND LIMITATIONS

The cover cannot take more than 10 minutes to put on/ remove.

It has to be able to be managed by one to two people.

The cover should cost less than \$500.

The pool covering must cover the entire area of the pool.

5. IDEAS

- Enhance Useful Parameters: Segment / modularize.
 - Make two layers so there are two chances for protection. The outer layer will be a thick plastic and the inner layer will be thin to catch what falls.

- Enhance Useful Parameters: Transform an object's shape.
 - Make one layer a pyramid shape to drain the debris off the sides, to act like a tent over the flat layer which is covering the pool.

- Enhance Useful Parameters: Use dynamic elements.
 - The pool cover can be rolled up around a plastic tube that rotates at one side of the pool by the use of a motor. The leaves collected on top will be pushed off the cover as it is rolled back by an angled bar at the base of the plastic tube.

- Enhance Useful Parameters: Adapt a tool to a person.
 - Make the cover out of hard plastic that has hinges at segments to fold back in steps like a naptime mat.

- Counteract Harmful Effects: Integrate into a poly-system.
 - Use a motor to uncover the cover.

- Lower Harmful Parameters: Use a mask or filter.
 - Provide a second layer that filters out debris above the original cover. This may be a layer of mesh on top of the plastic cover.

- Increase Effectiveness: Replace filter with more effective.
 - Create surface that zaps fine debris with a laser or removes it via moving air. This will also evaporate water.

- Enhance Useful Parameters: Strengthen individual parts.
 - Instead of using a thin plastic for the cover, hard, plastic pieces that link together can be used to lie across the top of the pool. The piece will come in the shape of the pool or for an odd shaped pool the linked pieces can be bought individually. The pieces will be smooth and can be cleaned off easily.

- Lower Harmful Parameters: Make an object dismountable / Separate in time: Use adjustable elements and links.
 - Using the hard, thick plastic pieces, one piece can be taken away without removing all the pieces.

- Increase Effectiveness: Make a road.
 - The pieces will lock into a track on the edge of the pool. This will prevent the pieces from sliding around.